

A proposal to study the occurrence of natural and anthropogenic (man-made) Cr VI near a mapped plume, Hinkley, CA

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Prepared under contract with the
Lahontan Regional Water Quality Control Board
in cooperation with the Hinkley Technical Working Group (TWG):

Hinkley Citizens Advisory Committee (CAC)

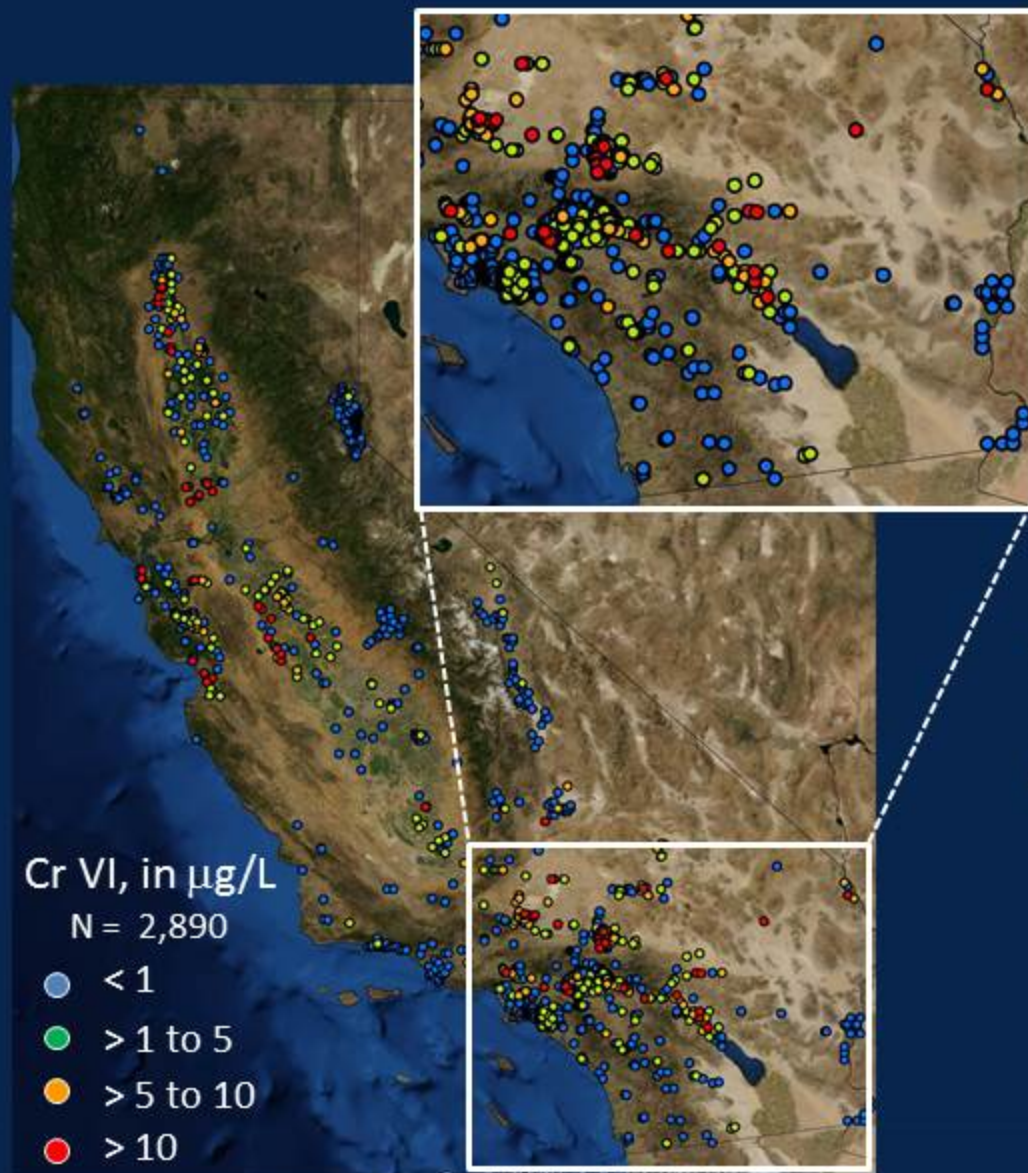
Project Navigator, Ltd.

Lahontan Regional Water Quality Control Board

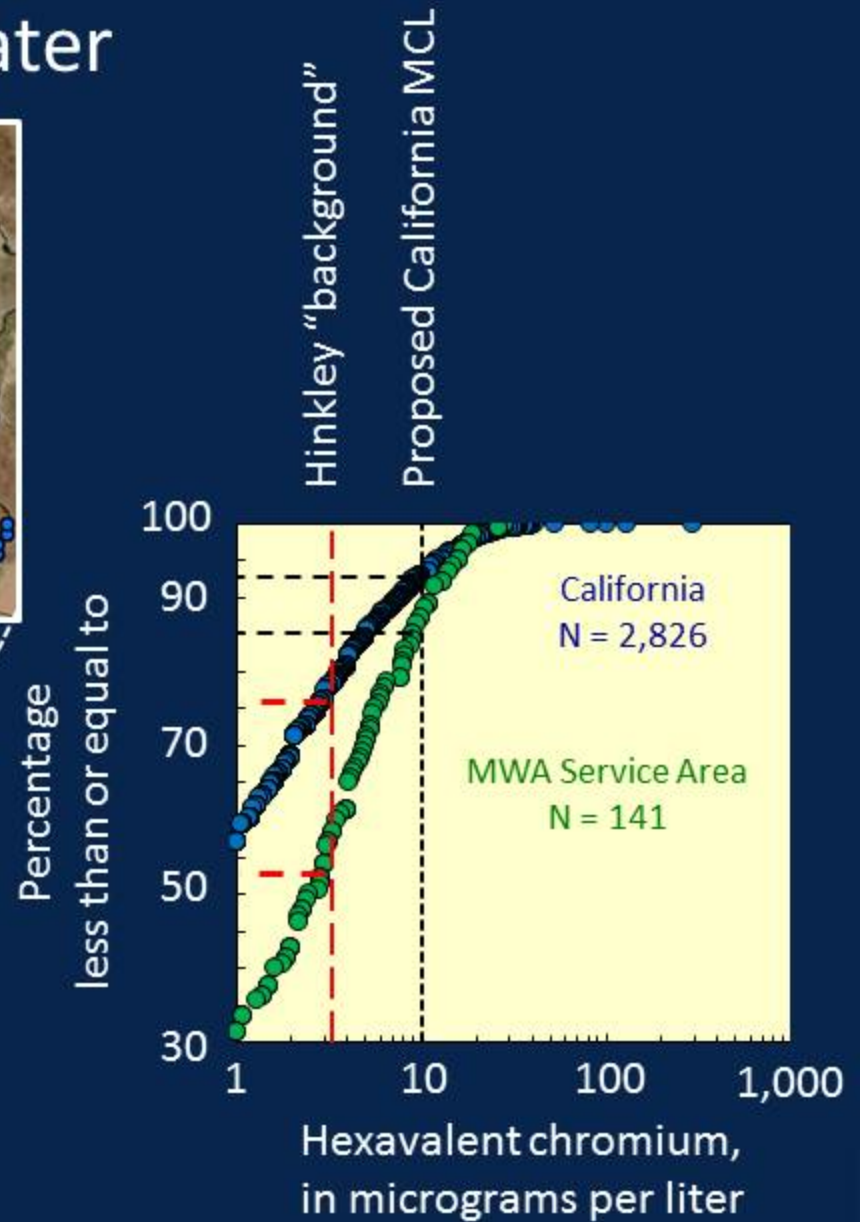
Pacific Gas and Electric Company and affiliated consultants
(CH2M-Hill, Stantec, and ARCADIS)



Cr VI in California's groundwater



U.S. Geological Survey GAMA data



Purpose

- Evaluate the occurrence of natural and anthropogenic (man-made) Cr VI
- Estimate background Cr VI concentrations upgradient, near the plume margins, and downgradient from the mapped plume near Hinkley, CA
- Issues are complex, but not unknowable
- Goal is to produce usable, understandable science-based information to assist Cr VI clean-up



Mapped extent of Cr VI ($> 3.1 \mu\text{g/L}$), 1st quarter 2013

0 5 Miles

Scope of proposal

- Evaluation of existing data
- Sample collection and analyses of rock and alluvium
- Sample collection and analyses of water (chemistry and isotopic tracer data)
- Evaluation of local conditions
- Evaluation of groundwater movement
- Evaluation of occurrence of natural and anthropogenic chromium
- Estimation of background Cr VI concentrations



Mapped extent of Cr VI (> 3.1 µg/L), 1st quarter 2013

0 5 Miles

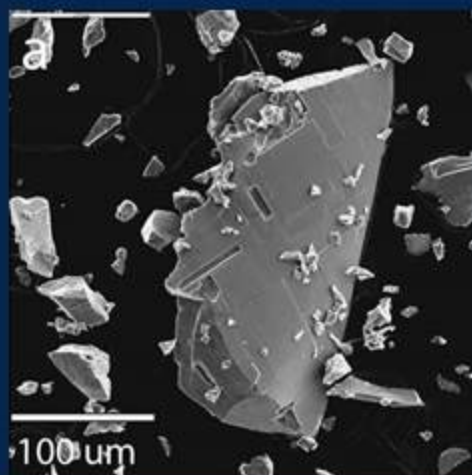
Task 2: Mineralogy

Chromium substituted within actinolite, western Mojave Desert, CA

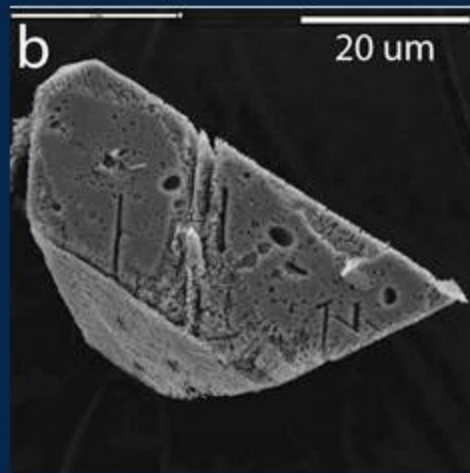


Abundant, massive
Cr in part per thousand range
Easily weathered

Chromite, Sacramento Valley, CA From Morrison and others, 2009



Unweathered



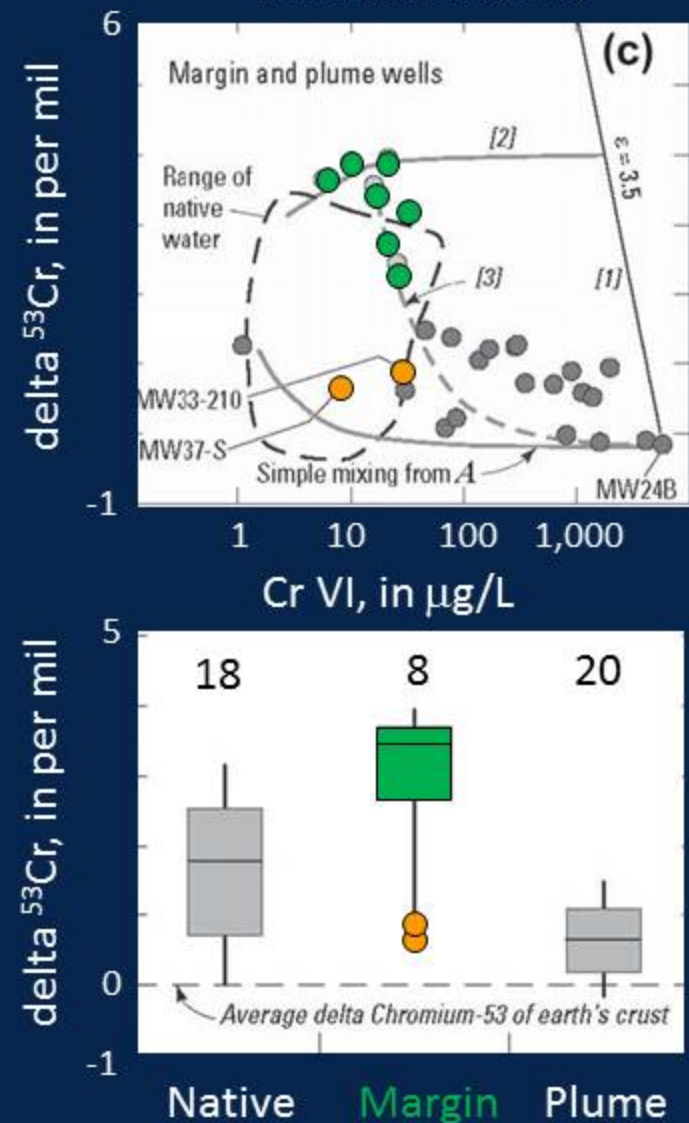
Weathered

Abundant, finely disseminated
Pure chromium oxide
Resistive to weathering

Task 3: Isotopic tracers of water and chromium

- delta Oxygen-18 and delta Deuterium
- Dissolved atmospheric gasses (N and Ar)
- Tracers of the age (time since recharge) of water
 - Tritium
 - Tritium / Helium-3
 - Industrial gasses (CFC's and SF₆)
 - Carbon-14
- Tracers of rock-water interactions (^{87/86}Sr)
- Chromium isotopes

Topock, CA
(Izbicki and others, 2012)



Task 3: Age-dating parameters and streamflow

Montreal Protocol

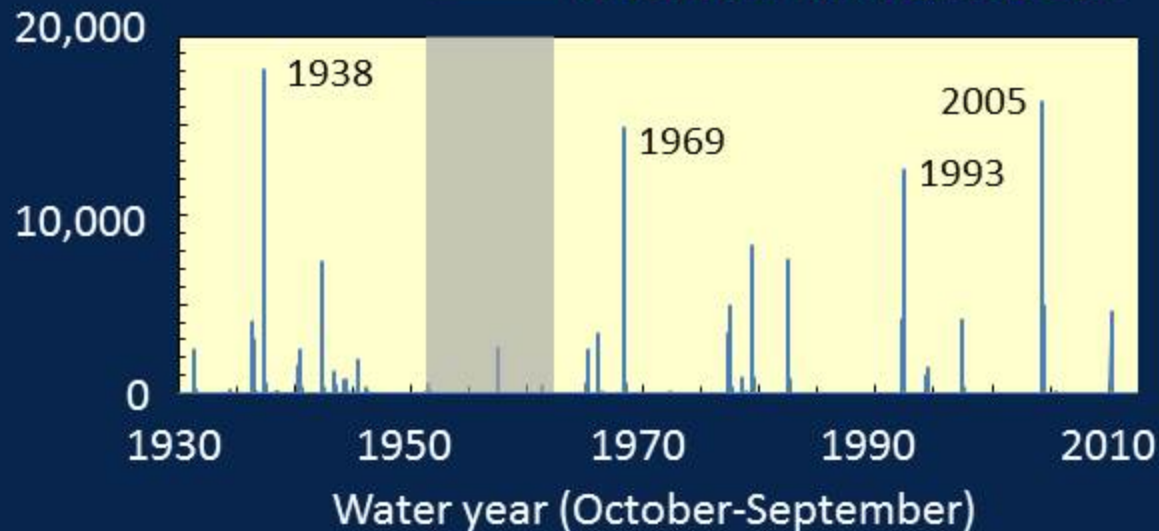
Industrial gasses (CFC's and SF₆)

Nuclear Testban Treaty

Atmospheric tritium

Chromium releases 1952-64

Maximum daily streamflow,
in cubic feet per second,
at Barstow, CA (10262500)



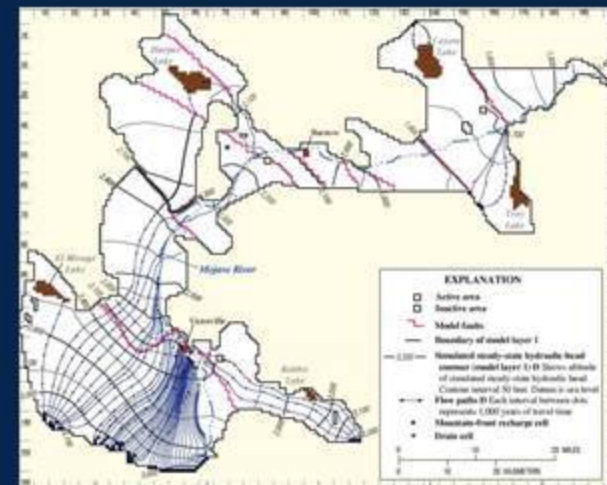
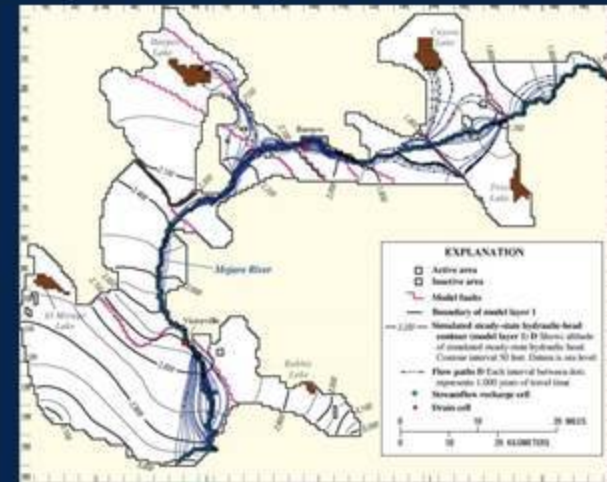
Limited streamflow and recharge
during period of chromium release

Task 5: Evaluation of groundwater movement

Use existing PG&E / CH2M-Hill groundwater flow model

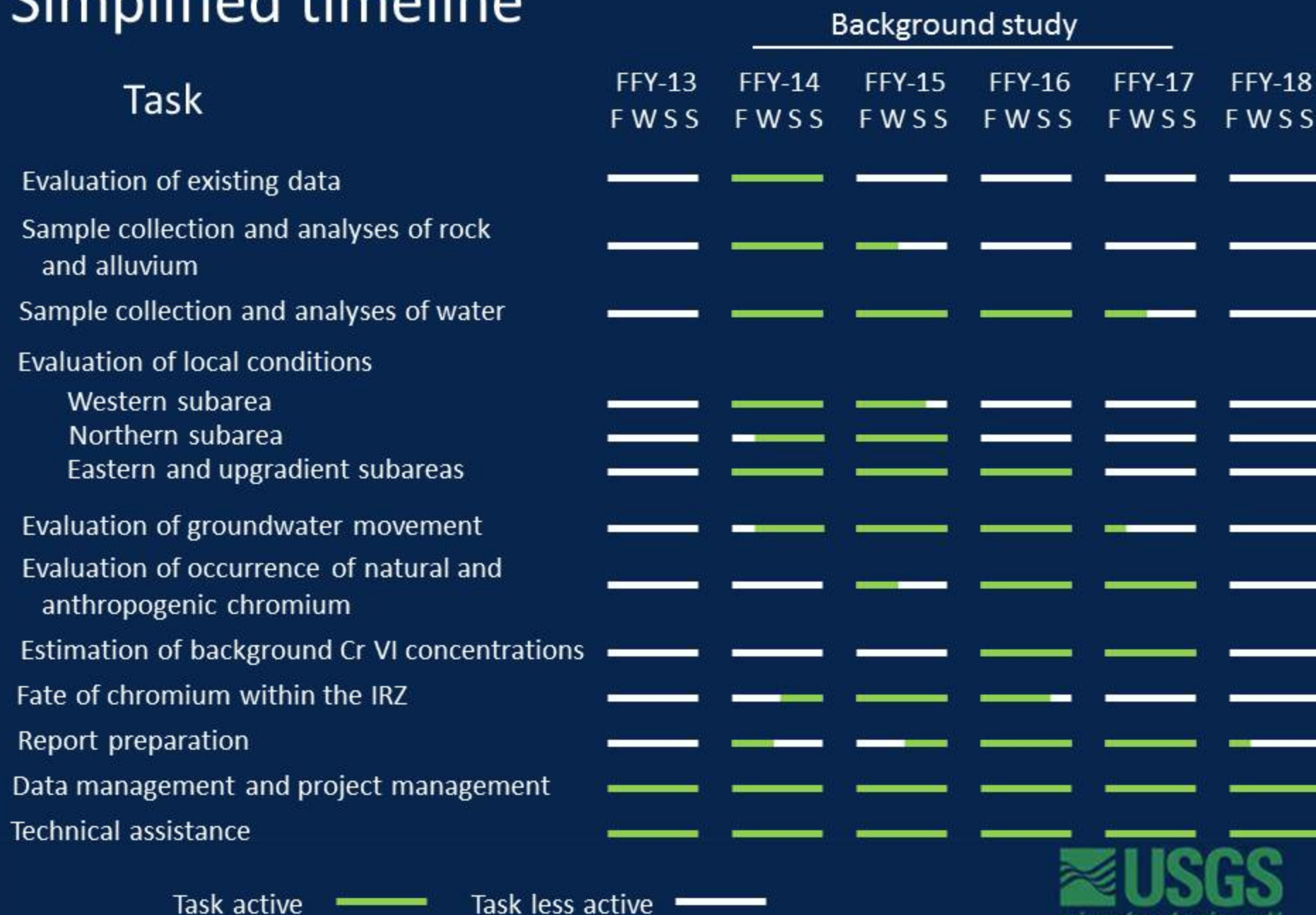
- Assess model suitability
- Update and recalibrate model
- Estimate historical groundwater levels
- Incorporate particle-tracker to assess historical groundwater levels and visualize and interpret groundwater age data

Particle-flow paths
floodplain and regional aquifers
Mojave River groundwater basin



From Stamos and others, 2001 and
Izbicki and others, 2004

Simplified timeline



Task active — Task less active —



Simplified costs

Maximum potential U.S. Geological Survey Federal Matching Funds	\$ 997,500
Cooperator contribution	<u>3,551,567</u>
Total	\$ 4,549,067

NOTE: Costs are FFY-13 costs. Costs are not burdened for inflation in FFY-14 through FFY-18.